Monkey (*Macacus cynomolgus*) from India, presented by Mr. Francis Pym; a Common Squirrel (*Sciurus vulgaris*), European, presented by Madame Hante; a Vulpine Phalanger (*Phalangista vulpina*) from Australia, presented by Capt. F. Ayling; a Pudu Deer (*Cervus humilis*), a Naked-eared Deer (*Cervus gymnotis*) from Chili, a Maned Goose (*Bernicla jubata*) from Australia, purchased; an Egyptian Gazelle (*Gazella dorcas*) from Egypt, deposited; a Frazer's Squirrel (*Sciurus fraseri*) from Ecuador, a Black Sternothere (*Sternothærus niger*) from West Africa, received in exchange.

UNDERGROUND TEMPERATURE[1]

OBSERVATIONS on a very elaborate scale have been received from the important mining district of Schemnitz, in Hungary. A request for observations was sent by the Secretary, in 1873, to the Imperial School of Forests and Mines at Schemnitz, and on the receipt of two thermometers a Committee was formed to plan and carry out observations. The leading part in the observations has been taken by Dr. Otto Schwartz, Professor of Physics and Mathematics, who has furnished an elaborate report of the results obtained. This is accompanied by a geological report drawn up by Prof. Gustav von Liszkay and by a geological map with plans and sections of the mines.

The two thermometers sent being deemed insufficient for the numerous observations which were contemplated, twenty-five large thermometers were ordered from a local maker (T. T. Greiner), and the ten best of these, after being minutely compared with one of the two thermometers sent—which was non-registering and had a Kew certificate—were devoted to the observations. Three of them were divided to tenths and the others to fifths of a degree Centigrade, and all had bulbs of thick glass to ensure slowness of action. They were found not to change their indications during the time requisite for an observation.

The observations were for the most part taken by boring a hole in the rock to a depth in the earlier observations of ·422, and in the later ones of ·79 of a metre, then filling the hole with water, and after leaving it in some cases for a few hours, in others for several days, to plunge a thermometer to the bottom of the hole, and after thirty or forty-five minutes take it out and read it. The tenths of a degree were read first, and there was time for this to be done before the reading changed. As a rule three observations were taken in each gallery, two of them in bore-holes to give the temperature of the rock, and the third in the air of the gallery at an intermediate position. Pyrites and also decaying timber were avoided as being known to generate heat, and as far as possible currents of air and the neighbourhood of shafts were avoided also.

A table, which forms part of Dr. Schwartz's report, contains observations made in no fewer than thirty-eight galleries. Besides the temperatures, it gives the depth of the place of observation beneath the shaft-mouth and the height of the latter above sea-level. Dr. Schwartz takes exception to a few of the observations in the table, as being vitiated by the presence of pyrites or by currents of air.

All the galleries mentioned in the table are classified according to the shafts with which they are connected, and there are for the most part six of these galleries to each shaft. In the final reductions, Dr. Schwartz compares the temperature in the deepest gallery of each shaft with the assumed mean annual temperature of the ground at the shaft-mouth. For determining this latter element the following data are employed.

The mean temperature of the air at the School of Mines, from twenty years' observation, is 7°·2 C. at the height of 612·6 metres above sea-level. The shaft-mouths are at heights of from 498 to 763 metres above sea-level, and it is assumed that the temperature of the air falls 1° C. for 100 metres of elevation. It is further assumed that the mean temperature one metre deep in the soil is, in these particular localities, 1° C. higher than the mean temperature of the air. The reasons given for this last assumption may be thus summarised:—

1. Observations in various localities show that in sandy soils the excess in question amounts on the average to about half a degree Centigrade.

2. In this locality the surface is a compact rock which is highly heated by the sun in summer and is protected from radiation by a covering of snow in winter; and the conformation of the hills in the neighbourhood is such as to give protection against the prevailing winds. Hence the excess is probably greater here than in most places, and may fairly be assumed to be double of the above average.

Omitting one shaft (Franz shaft), in which, owing to the presence of pyrites, the temperatures are abnormal, the following are the principal results:—

	Depth in metres.	Increase of temp. Cent.	Quotient, or metres per 1° C.	Feet per 1° F.
Elizabeth shaft	417	8·5	49·1	89·5
Maximilian ,, ...	253	6·4	39·5	72·0
Amalia ,, ...	285	8·1	35·2	64·2
Stefan ,, ...	218	7·2	30·3	55·2
Siglisberg ,, ...	414	8·1	51·1	93·2
Sums, &c.	1587	38·3	41·4	75·5

The best mode of combining the results from these five shafts is indicated in the last line of the above table, where the sum of the depths is compared with the sum of the increments of temperature. We have thus a total increase of 38°·3 C. in 1,587 m.; which is at the rate of 1° C. in 41·4 m., or 1° F. in 75·5 feet.

As these results depend on an assumption regarding the surface-temperature, it seems desirable to check them by a comparison of actual observations, namely, by comparing the deepest with the shallowest observation in each mine. We thus obtain the following results:—

	Difference of depth, metres.	Difference of temperature, Cent.	Quotient metres per deg. Cent.	Feet per deg. Fahr.
Elizabeth shaft	145·2	4·6	31·6	57·6
Maximilian ,, ...	191·6	3·9	49·1	89·5
Amalia ,, ...	228·2	5·1	44·8	81·7
Stefan ,, ...	82·0	4·7	17·4	31·7
Siglisberg ,, ...	400·3	8·0	50·0	91·2
Sums, &c.	1047·3	26·3	39·8	72·5

Combining these results in the same manner as the others, we have a total difference of 26°·3 C. in 1047·3 metres, which is at the rate of 1° C. in 39·8 metres, or 1° F. in 72·5 feet.

The near agreement of this result with that obtained from comparison with the assumed surface-temperature is very satisfactory. The mean of the two would be 1° F. in 74 feet.

The rocks consist, for the most part, of trachyte and greenstone.

Dr. Schwartz concludes his report with the suggestion that the heat developed by the decomposition of pyrites and galena in seams which are not altogether air-tight and water-tight, may possibly be utilised as a guide to the whereabouts of metallic lodes; and that "we shall thus obtain, by means of the thermometer, scientific information which the ancients sought by means of the divining-rod."

Thanks are due to M. Antoine Péch, Ministerial Councillor, and Director of the Mines, and to Herr Edouard Pöschl, Director of the School, for energetic co-operation in this extensive and valuable series of observations.

Mr. Lebour, having been requested to supplement the above *résumé* of the Schemnitz observations by an account of the connection (if any) between the geological and thermal conditions of the several mines, as indicated by a comparison of the reports of Dr. Schwartz, and Prof. von Liszkay, remarks:—

"The rock at all the mines except Franzschacht is green

[1] Report of the British Association Committee on Underground Temperature, by Prof. Everett.

hornblende-andesite (*in German* Grünstein-trachyt), a compact fine-grained crystalline, more or less vitreous rock, containing crystals of oligoclase and hornblende, but *no quartz or sanidine*. This rock is a good heat-conductor, with a conductivity probably nearly approaching that of 'Calton trap rock.'

"The Franzschacht is sunk in rhyolite (a highly siliceous vitreous trachyte), a rock, the conductivity of which would presumably be nearly the same as that of hornblende-andesite, probably a little greater. Elements of temperature-disturbance are, however, present in the form of thermal springs, and, possibly, in the proximity of a basaltic cone. This last element of disturbance is, I should imagine, a very doubtful one indeed, although Councillor A. Péch appears to think it of importance. The rate of increase, as deduced from observations in the rhyolite here, was 1° C. for 40·55m., or about 1° F. for 74 feet.

"The report brings out strongly the important variations of rock-temperature which may be, and are occasionally, generated by the decomposition of metallic sulphides, a point which I think is here prominently mentioned for the first time."

At the request of Mr. Lebour, observations have been taken by Mr. Matthew Heckels, Manager of Boldon Colliery, between Newcastle and Sunderland, in holes bored upwards to a distance of ten feet from some of the deepest seams.

The mine is described as "perfectly dry," and those parts of it in which the observations were made are quite free from currents of air. The surface of the ground is tolerably level, and is ninety-seven feet above Trinity high-water mark.

Hole No. 1 is bored up from the roof of the Bensham seam. The thermometer—one of the new slow-action instruments, not self-registering—was placed at the end of the hole (so as to be ten feet within the rock) and protected by air-tight plugging. The surrounding strata consist of arenaceous shale, known as "grey metal." The distance of the thermometer from the surface of the ground overhead was 1,365 feet.

The hole had been standing idle for some time when the thermometer was inserted, April 5, 1876. The first reading was taken April 26, and was 75°, the surrounding air being at $75\frac{1}{2}$°, and almost stagnant. The readings were repeated during four consecutive weeks, without change of the indications.

Hole No. 2 is in the same vertical with No. 1, and is bored up (also to the height of ten feet) from a deeper seam—the Hutton seam. The same thermometer was employed, and in the same manner. The surrounding strata consist of a close, compact sandstone known as "hard post." The distance of the thermometer from the surface of the ground overhead was 1,514 feet. Immediately after the drilling of the hole, June 6, 1876, the thermometer was inserted, and on July 4 the first reading was taken, namely, 81°. On July 24 it had fallen to $79\frac{1}{2}$°, and on August 1 to 79°. Readings taken on August 15 and 29 and September 1 also showed 79°, the surrounding air having never altered from the fixed temperature, $78\frac{1}{2}$°. It would therefore appear that the first observation in this hole was 2° too high, owing to the remains of the heat generated in boring, notwithstanding the lapse of four weeks which had intervened. Four readings have since been taken at regular intervals, ending with July, 1877, and the same temperature, 79°, continues to be shown.

Assuming 48° as the mean annual temperature of the surface, we have the following data for calculating the rate of increase downwards:—

Surface	48°
1,365 feet	75°
1,514 feet	79°

For the interval of 149 feet between the two holes we have an increase of 4° F., which is at the rate of 1° F. in 37 feet.

For the whole depth of 1,514 feet from the surface to the lower hole we have an increase of 31°, which is at the rate of 1° F. in 49 feet.

In explanation of the length of time required for the heat of boring to disappear in the second hole, Mr. Heckels remarks that "it required two men sixteen hours with a hand-boring machine to drill this hole, so hard is the stratum." He further says: "The tool by which this hole was bored, on being drawn out, was too hot to allow it being touched with the hand, so that the temperature of the hole, on being finished, must have been considerable; and no doubt it would be when we consider the immense pressure required to bore holes in such strata as this." With respect to the permanent temperature, $78\frac{1}{2}$°, of the surrounding air, Mr. Heckels remarks: "The air of this district is almost stagnant, and what circulation there is will have travelled a distance of three miles underground; and hence it may be expected to be itself pretty near the temperature of the rocks through which it is circulating."

The dryness of the mine, the absence of currents of air, and the great depth render these observations extremely valuable for the purpose which the Committee have in view, and their best thanks are due to Mr. Heckels and the proprietors of the colliery for the trouble and expense which have been incurred in procuring them. Observations will shortly be taken in another bore in the same colliery.

During the past year the first observations have been received from India. They were taken by Mr. H. B. Medlicott, M.A., of the Geological Survey, in bores made in search of coal, and have been published by him in the "Records of the Geological Survey of India," vol. x., part 1. The instrument employed was a "protected Negretti" thermometer sent by the secretary of this Committee to Dr. Oldham, the director of the Survey. A Casella-Miller thermometer was used to check the observations, but was found much less sensitive and steady, and its readings, though placed on record, are therefore left out of account by Mr. Medlicott in his reductions.

The observations were taken in three bores, at places named Khappa, Manegaon, and Moran; but the observations at Moran were made only four hours after the boring tool had been at work, and the Khappa bore exhibited a strong bubbling, besides other marks of convection. The results obtained at these two bores must therefore be discarded; but in the Manegaon bore everything was favourable for satisfactory observation. "It was closed on April 24, 1875, so that it had been at rest for twenty months. There is only one guide-pipe ten feet long at the top of the bore, there never having been any pressure of water in the hole. The position is low, and the water had always stood at or near the mouth of the tube. There was no difficulty in removing the plug. The very equable series of temperatures is the natural result of these conditions. The observations were taken in the evening of the 5th and morning of the 6th of December. At 5 P.M. the air-temperature was 72°; at 8 P.M., 59°; at 8 A.M., 65°; at 11 A.M., 84°. The slight decrease of temperature in the top readings is a good proof of the perfectly tranquil conditions of observation. It is no doubt due to the excess of summer heat not yet abstracted; and it is apparent that that influence reaches to a considerable depth—quite to sixty feet." The following are the observations:—

Depth, feet.	Temperature, Fahr.	Depth, feet.	Temperature, Fahr.
10	81·15	150	82·7
20	81·1	200	83·3
40	81·0	250	84·0
60	81·0	300	84·65
80	81·3	310	84·70
100	81·8		

This last observation was in mud, the hole, which had originally a depth of 420 feet, having silted up to such an extent that 310 feet was the lowest depth attainable. The increase from 60 feet downwards is remarkably uniform, and the whole increase from this depth to the lowest reached is 3°·7, which is at the rate of 1° F. for 68 feet.

The elevation of Manegaon is estimated at 1,400 feet. It lies "in an open valley of the Satpuras, traversed by the Dudhi River, south of the wide plains of the Narbada Valley, about halfway between Jabalpur and Hoshungabad, which are 150 miles apart." Jabalpur is 1,351 feet above sea-level, and has a mean annual temperature of 75·2. Hoshungabad is 1,020 feet above sea-level, and has a mean annual temperature of 78·3.

"The geological conditions of the position are favourable for these observations. The rocks consist of steady alternations, in about equal proportions, of fine softish sandstones, and hard silty clays of the upper Gondwana strata, having a steady dip of about 10°. . . Strong trap dykes are frequent in many parts of the stratigraphical basin; but there are none within a considerable distance of these borings. There are no faults near, nor any rock-features having a known disturbing effect upon the heat-distribution."

Mention was made in last report (p. 209) of two methods which had been suggested by members of the Committee for plugging

bores to prevent the convection of heat. Mr. Lebour, at the request of the Committee, has conducted experiments during the past year on both forms of plug. He reports that :—

"In accordance with Sir W. Thomson's suggestion, discs of india-rubber fixed to the lowering wire above and below the thermometer have been tried. The chief difficulty met with was the unwieldiness of the armed portion of the wire, which could not be wound and unwound from the drum, owing to the fixed disc-holders. This difficulty prevented the placing of the discs anywhere but at the extremity of the wire, whereas it would be very desirable to have a large number of them at intervals along the greater part of its entire length. Discs for a $2\frac{1}{2}$-inch bore were found to work well with a diameter of $2\frac{1}{4}$ inches. The lowering, and especially the raising, of the wire armed with the disc-plugging were very slow operations, owing to the resistance opposed by the water to the passage of the discs.

Experiments with the form of plug devised by Mr. Lebour himself were continued with a set of better made plugs. "The great disadvantage of this system of plugging is the necessity for using two wires, one to lower the thermometer and plug as usual, and the other to let down weights upon the upper ends of the plugs, when they are to be expanded, and to remove them when they are to be collapsed. This necessitates not only the ordinary drum for the first wire, but also an independent reel for the second. With care, however, and after some practice, the apparatus was found to work well; but it certainly is extremely inconvenient for rapid work, as it requires a good deal of setting up."

Experiments were made with both forms of plug at the depth of 360 feet, in a bore of the total depth of 420 feet. In the one case, eight india-rubber discs were employed, four above and four below the thermometer; in the other, two collapsible plugs, one above and the other below. The experiments had chiefly in view the mechanical difficulties of the subject, and are not decisive as to the sufficiency of the plugs to prevent convection.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

PROPOSED NEW UNIVERSITY.—A movement has for some time been on foot for the establishment of a new university in the north of England, and on Tuesday last week a deputation, which included the Rev. Dr. Gott (Vicar of Leeds), Mr. Edward Baines, Prof. Thorpe, Prof. Rücker, and Mr. R. Reynolds, waited upon the Mayor of Bradford, Mr. B. Priestly, with the object of inducing the Corporation of Bradford to adopt a memorial to the Privy Council in favour of the proposal. The Mayor intimated that the matter would be referred to the Finance and General Purposes Committee of the Corporation for consideration.

FRANCE.—A commission of twenty-two members has been appointed by the Chamber of Deputies of the French Republic, to prepare a general law on primary instruction.

Two new professorships of botany have been created in the faculties of Lille and Rennes.

PARIS.—The medical course at the University is attended at present by 23 ladies, including 12 Russians, 6 English, and 5 French. Since 1865, 30 ladies have studied medicine at Paris, 9 of whom have received the doctor's diploma.

HIGHER FEMALE EDUCATION.—The subject of the admission of female students to the universities is exciting at present an unusual degree of discussion in Germany as well as in England. In this connection we notice the publication of a letter from Prof. G. H. Meyer, of the medical faculty of Zurich, in which he states, as the result of the experience of a number of years with female students, that he can detect no difference in the average amount of talent and application shown by the representatives of the two sexes under his charge. From a social as well as a professional standpoint, the advanced position taken by the University of Zürich in this direction, during the past few years, is shown to be justified.

KÖNIGSBERG.—The university is attended at present by 655 students, including 42 in the theological faculty, 174 in the legal, 134 in the medical, and 305 in the philosophical. But 42 are from outside of Prussia. The corps of instructors numbers 40. The university possesses a library of 155,000 volumes, an observatory, the zoological museum founded by von Baer, and numerous clinics. On February 2 the eminent philosopher, Herr Rosenkranz, celebrated the fiftieth anniversary of his receiving his doctor-diploma. The German Emperor, the Crown Prince, and all the German Universities, sent congratulatory telegrams and addresses.

HALLE.—On February 27 the 150th anniversary of the establishment of an agricultural chair was celebrated at the Halle University. At the same time the fifteenth anniversary of the opening of the Halle Agricultural Institute, under the direction of its founder, Prof. Kühn, was solemnised. A torchlight procession and banquet were followed by the laying of the foundation-stone for a new geological museum, which is principally destined to contain a geognostical collection of the most important formations in their natural form and succession.

MUNICH.—The rapid increase in the attendance shows that this young University is taking a leading position in Germany. At present the students number 1,360, an increase of over 200 on 1876–77. The philosophical faculty contains 400, and the medical 340. Countries outside of Bavaria are represented by 346. The corps of instructors number 114.

GIESSEN.—The university is attended at present by 315 students, of whom 237 are natives of Hesse. There are but 16 students of chemistry, a striking contrast to the numbers which were wont to flock from all quarters to Liebig's laboratory.

MARBURG.—The number of students in attendance on the university during the past winter was 415. They were divided among the faculties as follows: —Theology 51, law 85, medicine 100, philosophy 179. The Prussian students numbered 263.

BONN.—The professorship of geology and palæontology in this university has been offered to the well-known geologist, Prof. von Seebach, of Göttingen.

KIEL.—The vacant chair of botany is to be filled by Prof. A. Engler, of Munich.

DRESDEN.—A congress of representatives from all the German technical institutions is to take place at Dresden shortly after Easter.

LEIPZIG.—A young lady has taken here, for the first time, the degree of Doctor of Jurisprudence in the legal faculty.

PRUSSIA.—The number of legal students in the various universities has increased so rapidly of late years that they now form three-tenths of the total number.

GERMANY.—From statistical results published by the *Neue Deutsche Schul Zeitung*, it is shown that 60,000 schools with 6,000,000 pupils are in existence in Germany, for a population of about 40,000,000 inhabitants.

MADRID.—The Royal School of Mines has recently celebrated its 100th anniversary and published a handsome historical work in commemoration of the event.

UPSALA.—The University is attended at present by 1,370 students, consisting of 331 in the theological faculty, 145 in the legal, 181 in the medical, and 713 in the philosophical. The corps of instructors numbers 110, including 30 ordinary and 9 extraordinary professors.

SCIENTIFIC SERIALS

Reale Istituto Lombardo di Scienze e Lettere, Rendiconti, vol. xi., fasc. i. and ii.—On some propositions of Clausius on the theory of potentials, by M. Beltrami.—On the composition of cheeses, and on the emanation of fat from their albuminoid substances during maturation, by MM. Musso and Menozzi.—On determination of the nitrogen in milk and its products, by M. Menozzi.—On the resistance of the helices of telegraphic electro-magnets, by M. Ferrini.—Experimental researches on heterogenesis; on the limit of productivity of organic solutions (third communication), by MM. Maggi and Giovanni.—Chemical manures, the agrarian industry, and funded property, by M. Gaetano.—On a reaction of substances reductive in general, and in particular of glucose, by M. Pollacci.—On granite in the serpentine formation of the Apennines, by M. Torquato.

Morphologisches Jahrbuch, vol. iv. part 1, commences with a paper of 111 pages by Max Fürbringer on the comparative anatomy and development of the excretory organs of vertebrata. Nearly fifty figures are given to illustrate the early stages of these organs in the common frog and salamander, a full *résumé* is given of all observations on those of other vertebrates; together with a discussion on their homologies, and on their indications of relationship to the segmental organs of worms.—A careful description of the anatomy of *Isis neapolitana*, n.sp., is given by